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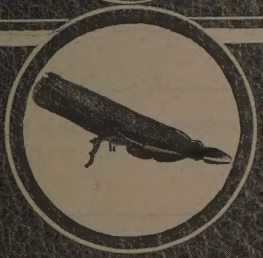
WEBWORMS INJURIOUS *to* CEREAL AND FORAGE CROPS *and* THEIR CONTROL



DEFORMED corn plants are often found to be infested by webworms, which gnaw the stem below the surface and by their ravages prevent the production of marketable grain. Grasslands of all kinds—meadows, pastures, lawns—furnish the normal food of sod webworms, and, although the injury is often difficult to estimate, under conditions favorable to the insect it may become very serious.

All of the feeding, whether upon corn or grass, is done by the insect in the larva or worm stage. Outbreaks of the various species of webworms in corn can be prevented only by cultural methods, such as early fall plowing, disking in the spring, the application of fertilizer, and the sowing of sound seed. Neither trapping nor poisoning has met with any success. Control of injury to grasslands is very difficult, and little can be done short of plowing up the sod and planting it to some immune crop.

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief
Washington, D. C. May, 1922

WEBWORMS INJURIOUS TO CEREAL AND FORAGE CROPS AND THEIR CONTROL.

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INJURY CAUSED BY WEBWORMS.

THROUGHOUT a large area in the middle eastern United States much damage is done annually by the corn and sod webworms. The insects which cause this damage are often overlooked and the injury attributed to other causes, but their method of work is so characteristic that once seen it is easily recognized thereafter.

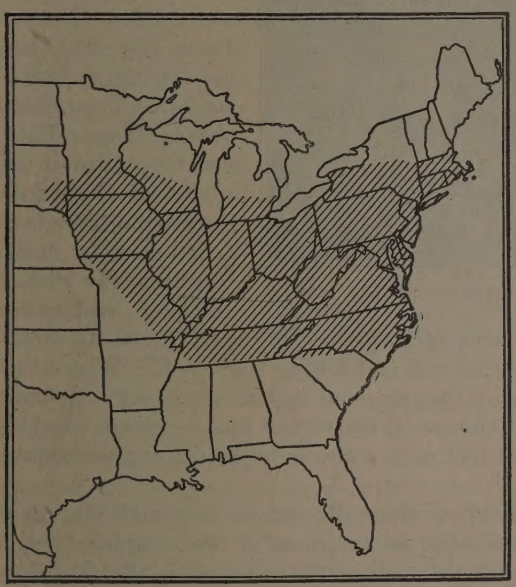

Fig. 1.—Approximate injurious distribution of webworms in the United States.

The section of the country where these pests occur and do their destructive work extends from New York and Massachusetts south to North Carolina and Tennessee and west to Iowa. These limits are roughly indicated on the map (fig. 1). Unlike most of our more destructive insect pests, the webworms are all natives of America and have not been introduced from foreign lands.

The injury caused by these worms is of two kinds: First, that done to cultivated crops, principally corn and tobacco, following sod or weed land; and, second, that occurring in meadows, pastures, lawns, and grasslands of all kinds.

The injury done by webworms to corn makes its appearance soon after the plants are up. With a little experience, the affected plants can be recognized at a glance. The leaves stand out from the stem more nearly horizontal than in healthy plants and usually are more or less eaten, ragged, and distorted. Sometimes the whole plant is curled and twisted into a shapeless tangle. Often the middle leaf or "growing point" is cut off at its base and dies. Occasionally the leaves above ground are eaten but usually the feeding occurs within or upon the stem below the surface (fig. 2), thus causing the deformed condition mentioned above. If an infested plant be pulled, it will be found that, from the ground level down to where the roots branch, the stem is scarred and eaten along one side, often with at least one hole reaching to its center, thus cutting off the middle leaf and killing the "bud." Where such plants are allowed to grow they send out suckers profusely and finally develop into deformed clumps of leaves and stems, seldom reaching a height of more than a foot or two and never producing marketable grain.

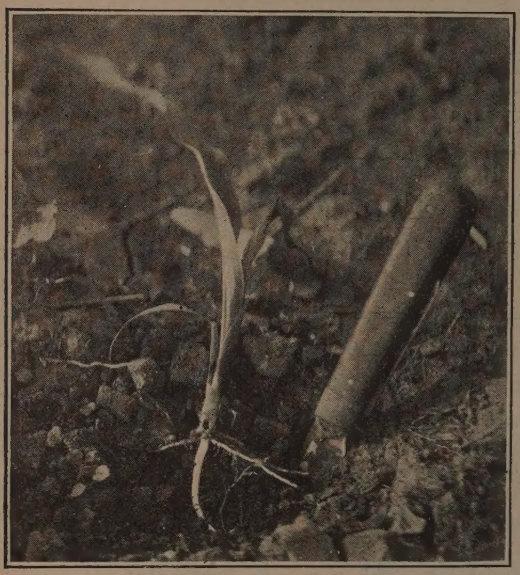

FIG. 2.—Corn plant showing injuries inflicted by a webworm.

If a small plant which is thus affected be carefully dug there will be found, close beside the stem, a more or less complete tube or shield of grayish silk mingled with particles of earth (fig. 3). This tube may be from one to several inches long and may or may not open to the surface of the soil. At its lower end it usually angles away from the plant and the worm which did the damage will probably be found hiding in the enlarged end or terminal pocket.

There are several other insects whose work on corn may be mistaken for that of webworm larvæ, but, as their common name indicates, the most characteristic feature about the webworms is the presence of the silken tube or web with which they invariably surround themselves. The work of billbugs, cutworms, southern corn rootworms, wireworms, and stalk-borers bears some resemblance to that of webworms, but a careful observer soon learns to distinguish the characteristics of each.

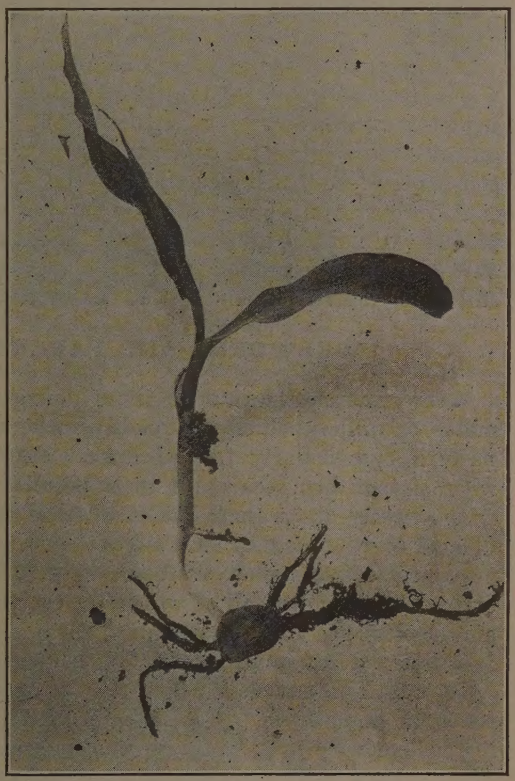

FIG. 3.—Seedling corn plant showing silken nest of webworm attached to stem at right just below surface of soil.

The presence of scars, pits, and gnawed places on the underground stem of the plant and the presence of a protecting silken web or tube are the characters which, almost with certainty, identify the cause of the injury as a webworm. The other type of injury by sod webworms is that done to meadows, pastures, lawns, and grasslands of all kinds. Under normal conditions sod webworms are grass feeders and will be found only in sod or grass clumps. In fact, the injury to corn described above is not normal to the habits of these insects and occurs only when sod or grasslands are plowed and planted to corn while the worms are still present in the soil. The injury to meadows and pastures is ordinarily inconspicuous and the degree of such injury is practically impossible to estimate in definite terms. That it is severe and a real factor in reducing the productivity of such lands may, however, be readily understood when it is realized that there are often many thousands of these worms to the acre, each cutting off and consuming several blades of grass every 24 hours. And they continue their de-

structive work not only in the spring when conditions are favorable for grass growth, but throughout the whole summer and even during the fall. Different species or additional generations of the same species follow one another so that at any time throughout the growing season these pests may be found actively at work. Especially in times of drought and when plant food is insufficient to permit rapid, thrifty growth, the sod webworms may consume practically all the growth as fast as it appears, thus leaving nothing for the owner of the land. In fact, there are on record several well-authenticated instances where the worms have stripped whole pastures and hay fields absolutely bare; in one instance, occurring in New York State, farmers of several counties found it necessary to dispose of their cattle because of the shortage of feed which resulted from the work of these insects. That such serious injury does not occur more often is due only to a combination of natural influences which prevents these worms reaching devastating numbers, and if at any time one or more of such forces fail to act, destruction and loss are likely to result.

WEBWORMS AND PARENT MOTHS.

Webworms are the caterpillars or young of certain small whitish moths or millers which are readily to be observed in meadows or pastures, particularly toward dusk. They are quite conspicuous when flying; but because of their peculiar habit of folding their wings closely about their bodies when at rest, they are often very difficult to see after they have alighted on a grass stem or leaf. There are many sorts of webworms, some 60 or 80 kinds being found in the entire United States, all of which are very much alike in both larva and moth stages. Practically all of these insects feed on grasses, but less than a dozen of them are of agricultural interest, as the others either attack unimportant wild grasses or are so rare that they are of no economic importance. All of them have the same stages in their life history but vary considerably in their seasonal history, and a knowledge of these differences is sometimes essential in planning control measures.

GENERAL LIFE HISTORY.

The eggs (fig. 4) are very small and are dropped indiscriminately by the female moths as they fly about over the grass at dusk and during the early hours of the night. Being dry, these eggs fall down among the grass stems and are therefore difficult to find. They hatch in a week or 10 days, and the young worms at once begin to feed on the grass leaves about them, cutting small pits in their surfaces. They immediately start the formation of the protective silken net within which they remain during their whole larval life. As they

grow larger they are soon able to eat the entire leaf, and when they become too large to be concealed within the fold of a leaf, descend and construct in the earth a burrow lined with silk, with an opening at the surface and sometimes continued upward along the grass stem in the form of a tube made of silk and bits of grass. From this time on the worms cut off the blades of grass entirely and drag them down into the burrow, where they feed in safety and at leisure. Often one finds a blade of grass projecting from the entrance of such a burrow while its motion and gradual disappearance indicate that down below the busy harvester is turning grass into worm as fast as possible.

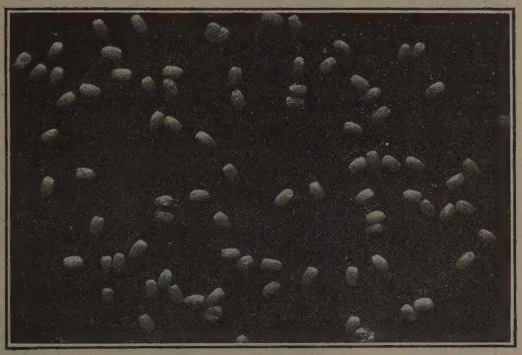

FIG. 4.—Eggs of a webworm moth. Much enlarged.

In order to allow for its rapidly increasing size the larva molts or sheds its skin several times until it reaches a length of half an inch or more, depending on the species (fig. 5). When its appetite is finally satisfied the webworm deserts the old burrow and in the earth near by constructs its cocoon (fig. 6), a neat little chamber with stiff walls of silk and earth, the whole about the size and shape of a peanut meat, although this often has a short neck or tube at one end opening at the surface of the ground. In this cocoon the worm awaits the change that shall transform it to the pupa or chrysalis (fig. 7). This period of waiting may vary in length from a few days to several months, depending on the particular species. The chrysalis is reddish-brown, helpless, and immovable except for the pointed abdomen, which can be rapidly rotated when it is disturbed.

FIG. 5.—Caterpillar of the black-headed sod webworm. About three and a half times natural size.

After a period of from 10 days to 2 weeks in the chrysalis stage, the moth (fig. 8) emerges from the chrysalis and forces her way out through the silken tube to the open air above, where, after a few

minutes' pause to spread and dry her wings, she is ready to mate and lay eggs with which to start the cycle anew. All the growing and feeding is done in the larva or worm stage, and it is in this stage only that these insects are harmful. The moths feed only on dew and live but a few days, or long enough to lay the eggs with which they are already filled when they leave the cocoon.

As there are several different species of these webworms, which vary somewhat in their habits, in their method of work, and in the means for their control, it will be best to discuss them separately.

FIG. 6.—Cocoons and pupæ of the striped webworm. Slightly enlarged. (The rule shown is a centimeter rule; an inch is 2½ centimeters.)

CORNROOT WEBWORM.[1]

The cornroot webworm, often known locally as the "budworm" or "wireworm," is by far the most injurious of the sod webworms attacking corn. Often some of the other species are associated with it, but in nearly every case where young corn is seriously injured by webworms the cornroot webworm may be charged with part of the trouble. It occurs from Pennsylvania to Iowa and southward to North Carolina and Tennessee and causes loss in some part of its range every year. In many sections where it occurs the farmers have grown to regard it as a necessary evil and anticipate having to replant at least part of the crop.

The small worms pass the winter in the earth, often around the roots of some of the more common weeds, such as "stickweed" (*Aster*

[1] *Crambus caliginosellus* Clem.

dumosus), plantain (*Plantago lanceolata*), and "fleabane" (*Erigeron* spp.). Very early in the spring, as soon as growth starts, the worms become active and continue to feed until they are fully grown. This is about the 1st of June in Tennessee and correspondingly later in more northern States. They construct their cocoons in the earth near their food plant and change to the pupa or chrysalis. Not all the worms make this change at the same time, but some of them after making their cocoons lie quietly for periods ranging from a few days to several weeks. Usually about 10 days is spent in the pupa stage.

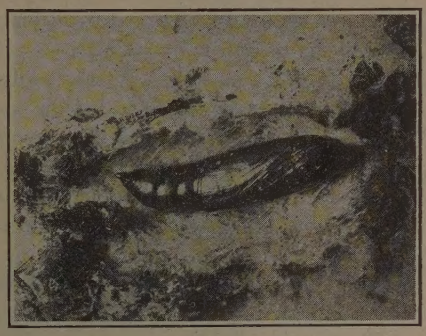

FIG. 7.—Pupa of the bluegrass webworm. About three and a half times natural size.

The first moths make their appearance toward the last of June and from that time through July and most of August some individuals are always present. It has been supposed that there might be a second or intermediate midsummer generation, but such does not seem to be the case. The moths are small and dark, sometimes almost black; they are quick fliers, and, because of their small size and dark color, are difficult to follow with the eye. They seem to prefer weedy and brushy areas, neglected fence rows, etc., and unless very abundant are not commonly found in open places. In Tennessee, at least, corn following fallow or weeds such as spring up after a wheat crop is more likely to be attacked by this species than after clean grass sod. Because of this fact many farmers think that the worms winter in the weed stems, but this is not the case, although many worms and larvæ very similar in appearance to the webworms can be found in such places. The eggs of the cornroot web-

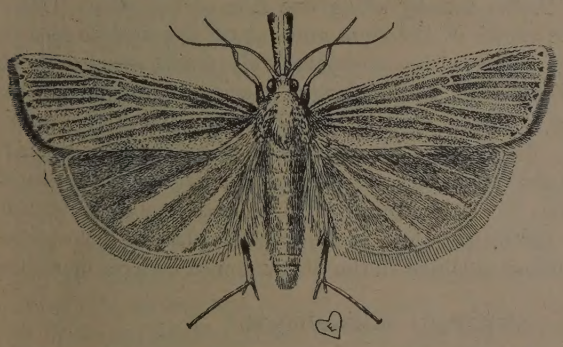

FIG. 8.—Adult of the black-headed sod webworm. About three times natural size.

worm are laid by the moths in July and August and soon hatch. The worms feed but little at this time and soon seek their winter quarters.

HABITS.

When found around corn plants in the spring these worms have a distinct yellowish appearance, sometimes almost golden yellow. Their heads are yellowish-brown; when nearing full growth they become lighter colored. After feeding has been completed they form cocoons in the earth, usually an inch or two away from the food plant. These cocoons are difficult to find and are often not recognized except by chance, because they look like pellets of earth. The time at which the worms cease feeding is determined by their stage of growth and not by external conditions, such as warm or cool weather, rain or dryness, and cultivation or the lack of it. Some of these factors may help or hinder the corn plants in recovering from the injury , but they have no perceptible effect on the worms.

The cornroot webworm is peculiar in that it seldom constructs a complete tube of webbing, but merely one side of it, the stem of the plant upon which it is feeding supplying the other side. This half tube or shield protects it from direct contact with the earth. The burrows do not open to the surface and all the feeding is done underground. The stem is attacked between the earth surface and the point where the roots branch. Irregular holes or pits are gnawed into the succulent tissue, usually along one side of the stem. Often these pits reach the center of the stem and cut off the middle leaf or leaves. This habit renders this comparatively small species much more destructive than some of the larger species of webworms because a plant once attacked usually is deformed beyond the possibility of recovery. The grower may be deceived by the fair appearance of the plants above ground and thus be led to believe that most of them will recover, but if on examination he finds any considerable proportion of the plants infested, he had better plan at once to replant, using the method outlined in the discussion of control measures (p. 15.)

STRIPED WEBWORM.[2]

The striped webworm (fig. 9), is one of the most common and widespread of the economic species. It occurs throughout the entire eastern half of the United States and as far west as Texas, Colorado, and South Dakota. It is one of the larger species, the worms when full grown being nearly an inch long. It is easily recognized by the four narrow, more or less distinct, whitish stripes along the back.

[2] *Crambus mutabilis* Clem.

The head is dull yellow with distinct black blotches. This species repeatedly has been found injuring corn but practically always in association with one or more other species and only where corn has followed freshly turned grass sod. While this is a larger species and a more vigorous feeder, its injury to young corn is not nearly so severe as that caused by the cornroot webworm because the striped webworm feeds almost entirely above ground and seldom injures the stem. This worm constructs a distinct, tubular burrow which opens at the surface of the soil and from which it emerges and either climbs the plants to feed on the leaves or cuts the leaves off at their bases and drags them to the entrance of the burrow, where it may feed without interference. Very seldom does any deformity result from its work and the plants attacked quickly recover from the loss of a portion of their leaf surface.

FIG. 9.—Adult of striped webworm. About three times natural size.

In grasslands, especially bluegrass meadows, large lawns, and parks, this worm is a frequent cause of premature browning and failure, especially in times of deficient rainfall. When laying their eggs the moths seek the lower and richer portions of the field where the grass is luxuriant, and the worms are usually more abundant in such places.

There are two generations and sometimes a partial third generation each year, the moths appearing in Tennessee during May, again in July, and again in lesser numbers in late August. The worms do their most conspicuous work on corn in April and by the first of May practically all the overwintering larvæ are mature. The summer generation, coming at a time when seasonal conditions are not so favorable, causes the injury to grass. The worms pass the winter in little cylindrical tubes of silk and grass fragments which they construct close to the earth among the grass stems (fig. 10).

Early fall plowing of grass sod on land intended for corn will greatly lessen their numbers the following spring. In meadows the application of a quick-acting fertilizer might serve to stimulate the growth of grass and aid it to overcome the work of the insects.

BLUEGRASS WEBWORM.[3]

Occurring throughout the eastern half of the United States and as far west as Colorado, the bluegrass webworm (fig. 11) is one of the most abundant species, at least in the southern part of its range. From May to the end of September the moths are present and often very abundant in almost every grassy area and weed patch. The moth is of medium size and may be identified by the white scales on the top of the head. The wings are yellowish gray.

FIG. 10.—Winter nests of caterpillars of striped webworm.

This species is strictly a grass feeder and has never been recorded as injurious to cultivated crops. As its name indicates, its favorite food is bluegrass,[4] although in captivity it can be reared on other grasses, including corn. It is included here because doubtless it is responsible for many prematurely brown pastures and lawns in midsummer.

The worm is dingy yellow and the head is without dark markings. The worms are hard to find in the field, for their burrows are carelessly made and without definite shape. They simply web together some grass stems and fragments at the base of the plant and emerge from this retreat to cut off and drag down one blade at a time until the whole tuft is bare of all green growth. The thousands and scores of thousands of these worms that at times are present in each acre of pasture severely curtail the amount of feed available for stock and reduce the vitality of the plants themselves. There are several generations of this insect each year, but they so overlap that for all practical purposes the worms and moths are continuously present.

BLACK-HEADED SOD WEBWORM.[5]

The black-headed sod webworm (fig. 8) is another grass-feeding species which, except in a few minor instances, has never been accused of injuring cultivated crops. It has shown itself capable, however, in several cases, of severe and costly damage to pasture lands and lawns. The most conspicuous recorded outbreak of this species occurred in northern New York State in the spring of 1881. In this

[3] *Crambus teterrellus* Zincken. [4] *Poa pratensis.* [5] *Crambus vulgivagellus* Clem.

instance practically all the pastures in several counties were completely stripped of every green blade of grass, appearing in late May as bare and brown as is usually the case in December. Most of such fields produced very little growth during the rest of the season and in many of them much of the grass died outright. While no such severe devastation has been observed since that time, it illustrates the severe injury of which any of these common grass-feeding webworms are capable of when all the conditions favor them.

The black-headed sod webworm has only one generation each year. The eggs are laid in August and September and soon hatch. The tiny worms feed for a few days until cold weather overtakes them and then remain quietly within their little silken galleries throughout the winter. With the opening of spring they become active and feed vigorously until they are fully grown, which usually is about the first of June. They then construct cocoons in the earth just beneath the surface and lie in them quietly until August, when they change to pupæ and emerge a week or ten days later as moths.

FIG. 11.—Adult of blue-grass webworm. About three times natural size.

The moth (fig. 8) is rather large, clay-yellow, flecked with numerous chocolate-brown scales and with gold fringes on the wings. It is conspicuous when flying and often very abundant. This is probably the most widely distributed of all the sod webworms, as it occurs from Texas to and throughout southern Canada and from Maine to California.

LEATHER-COLORED SOD WEBWORM.[6]

The leather-colored sod webworm is one of the largest of the sod webworms, the mature worm reaching a length of about an inch and the moth spreading about an inch and a quarter. The moth is yellowish gray and the larva or worm dark leather-brown or dingy yellow clouded with brown. This species occurs entirely across the continent in southern Canada, south to Tennessee east of the Mississippi, and almost to the Mexican border in New Mexico. It is abundant and destructive over an area extending from Ohio to Iowa.

There are two or three generations each year. Only small larvæ live throughout the winter. In the fall, usually in October, each tiny larva spins a thin but tough, white, silken case closely about itself and remains tightly coiled in this case until April, when it again begins to feed. These overwintering larvæ complete their

[6] *Crambus trisectus* Walk.

growth about the 1st of June, and it is at this time that they cause the injury to young corn. They have also been reported destroying fields of small grain in early spring. The moths emerge during June and lay eggs for the second or summer generation.

The worms of this summer generation reach maturity during July, and are responsible for damage to meadows, pastures, and lawns. In the southern portions of the insect's range, and in favorable seasons farther north, moths of this second generation appearing in late July give rise to still another generation which appears in late September and October, but this third generation when present is usually smaller and of no economic importance except that it provides the small larvæ which pass the winter.

The worms of this species are vigorous and active and feed freely. They construct definite tubular burrows opening at the surface and feed by cutting off the leaves and dragging them down into their retreats. Each worm during its life eats from 7 to 13 linear feet of blue-grass leaf or its equivalent, and as there are often thousands of them to the acre, it is evident that they may very materially reduce the amount of pasturage for stock or grass for hay.

SILVER-STRIPED WEBWORM.[7]

The silver-striped webworm should be mentioned because of a single small outbreak which occurred in the spring of 1919 in Connecticut. A small field of corn following spring-plowed grass sod became practically a total loss because of these worms. They worked very much as does the cornroot webworm, cutting into the stalk below ground and either killing the plant outright or causing it to become hopelessly deformed. Previous to this outbreak occasional specimens had been taken on various plants, including timothy, wheat, and corn, but not in sufficient numbers to warrant calling it a pest.

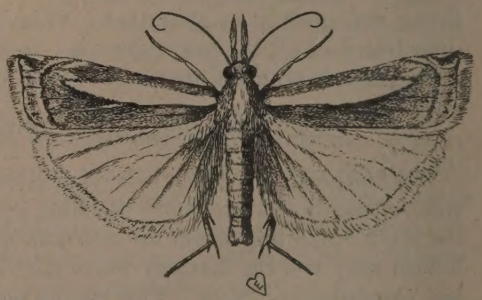

FIG. 12.—Adult of silver-striped webworm. About three times natural size.

The worm is dirty white or gray, with a pale yellow head, quite conspicuously blotched with brown. The moth (fig. 12) is bronze yellow with a single silver stripe running lengthwise in the middle of the forewing. The species is of wide distribution over the eastern

[7] *Crambus praefectellus* Zincken.

half of the United States, but is seldom abundant at any one point. There are several generations each year, the exact number depending on the latitude. The moths seem rather hardy and usually are the first of the webworm moths to be seen in the spring and the last in the fall. The larvæ feed on several kinds of grasses and very likely on other plants as well. It is only one of several species of webworms which may easily become pests if natural conditions favor their multiplication.

GENERAL CONTROL MEASURES.

As there are two main types of injury inflicted by the sod webworms, there are also two main types of control.

For the first type of injury, that to young corn, prevention is better than remedy. In fact, after the corn is once planted and the field is found to be infested there is no practicable method of getting rid of the worms and the only thing that can be done is to produce conditions that will permit the corn to grow in spite of them.

Land that has been in sod, either pasture or meadow, and land that has lain fallow and has grown up to weeds and grass, should be plowed the fall before it is intended to plant it to corn. The earlier it is plowed the better; it should be done in July or August if possible. Plowing in late October and November seems to show very little more beneficial effect in reducing the worms than plowing early the following spring before the corn is planted. It seems probable that the worms are practically all in their winter webs by the middle of October, and even earlier than this farther north, and when they have once sealed themselves up for the winter they are so securely protected that plowing does not injure many of them. Thus it may be seen that fall plowing to be effective must be done early enough to disturb the worms before they have finished feeding and, by the destruction of their food, either starve them before winter or force them to go into winter so poorly protected that many of them die before spring. Such fall-plowed land should be disked or otherwise cultivated in the spring until time for corn planting so that grasses and weeds may be kept down and any worms that may have survived the winter may be starved out.

If, after the corn is up, it becomes evident that it is going to be seriously injured, another course is necessary. If the season is still early and the corn small, delay a few days, if possible, until all the worms in the soil shall have found the corn and begun work upon it. Then without disturbing the corn already growing, replant the field so that the newly planted rows lie midway between the old infested rows. Allow both plantings to stand. The field can be harrowed

and, with care, cultivated the first time without seriously disturbing the first planted corn. By the time for the second cultivation most of the worms will have finished feeding and at this time the old corn can be cultivated out, leaving the second planting to occupy the field. It usually is a waste of time and seed to replant the crop in the same rows or hills with the infested plants unless it is very late in the season, because the worms merely turn their attention to the younger plants and soon the condition of these is no better than that of the first planting. Instances have come to notice where four successive plantings were made in the same rows and all but the last of these totally destroyed. The time at which the worms cease feeding varies with the location of the infestation. Seldom is any damage done in Tennessee after June 1. Farther north this date is later, perhaps as much as a month later in northern Ohio and Iowa.

It should also be stated that deep plowing, thorough preparation of the seed bed, the application of fertilizer, sound healthy seed, and any other factors which favor the corn plant will materially lessen injury. It has often been noted that corn growing in some particularly fertile spot in the field, perhaps where a stack has stood or where manure has been spread liberally, will escape almost without injury when the rest of the field is nearly destroyed. Corn plants can stand some mutilation of the outer leaves without apparent injury, if only the growing center or "bud" is not injured. The fast growing, vigorous plants are in much better condition to resist injury and to recover when injured than those already handicapped by other unfavorable conditions.

Rotation is not always a factor in the control of these insects, in fact not a single instance has been recorded where corn after corn was injured.

The possibilities of control for the other type of injury, namely, that occurring to grasslands, are much less. Little can be done that is likely to have much effect on the number or activities of the worms short of plowing up the sod and planting it to immune crops. Application of lime when needed, or of manure as a top-dressing, or any other treatment which will increase the vigor and thriftiness of the grass will lessen the proportion of loss. None of the attempts to poison the worms or to poison or trap the moths have proved successful, and in the main the tried and proved cultural practices which underlie good farming must be depended upon for control.

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